MULTIMEDIA



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# MULTIMEDIA UNIVERSITY

## FINAL EXAMINATION

TRIMESTER 2, 2015/2016

### TCS 3311 – COMPILER DESIGN/ TCP2451 – PROGRAMMING LANGUAGE TRANSLATION

(All Sections / Groups)

11 March 2016 9 AM - 11 AM. (2 Hours)

#### INSTRUCTION TO STUDENT

- 1. Answer ALL questions.
- 2. This question paper has 4 printed pages excluding the front cover.
- 3. Please print all your answers in the answer booklet provided.

(a) For a regular expression:

(a\* | b\*) a

Draw a NFA that can recognize the regular expression using Thompson's construction approach. The alphabet set is  $\{a, b\}$ .

[5 marks]

(b) Name two main differences between a NFA and a DFA.

[4 marks]

(c) Convert the NFA you derived in question 1(a) to a DFA using subset construction method. Also show the generated transition table.

[6 marks]

Continued ......

(a) Given a BNF grammar bellow, remove left recursion in the grammar

$$E \rightarrow E + T \mid T$$
  
 $T \rightarrow T * F \mid F$   
 $F \rightarrow (E) \mid id$ 

[3 marks]

(b) Compare the BNF grammar of question 2(a) with the left recursion eliminated grammar you produced, which one is an ambiguous grammar or neither. Justify your answer.

[2 marks]

(c) Perform a FIRST and a FOLLOW operation on each of the non-terminals in the modified grammar of question 2(a). (Hint: Use the grammar you derived after the left recursion elimination)

[10 marks]

Con	tinued					
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(a) Given the following grammar:

$$S \rightarrow \# P \# \mid E$$
  
 $P \rightarrow P, P \mid E$   
 $E \rightarrow /$ 

Draw the DFA to be used to build an LR(0) shift-reduce parser. If there is any conflict, identify the kind of conflict scenario you faced and which state exactly caused the conflict.

[7 marks]

(b) Study the following production rules and semantic rules. Identify inherited attributes and synthesized attributes in the semantic rules.

PRODUCTION RULES	SEMANTIC RULES				
T -> FT'	T'.inh = F.val T.val = T'.syn				
T' -> *FT' <sub>1</sub>	$T'_1.inh = T'.inh \times F.val$ $T'.syn = T'_1.syn$				
Τ' -> ε	T'.syn = T'.inh				
F -> digit	F.val := digit.lexval				

[4 marks]

(c) Ensuring type-safety is done using type binding and type checking. Elaborate various type binding mechanisms and type checking mechanisms. Provide examples in your elaboration.

[4 marks]

Continued ......

a) Illustrate the quadruples three-address code approach to represent the following as intermediate code.

$$a := b * - c + b * - c$$

[6 marks]

- b) Illustrate using examples how the following peephole optimizations work.
  - i) Algebraic simplifications
  - ii) Constant folding
  - iii) Eliminating unreachable code

[6 marks]

c) Calculate the total cost of instructions for the following addressing modes

MOV R0, M MOV 4 (R0), M MOV \*R0, M

[3 marks]

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